

## 1 DISTRACTION PIN FOR FRACTURE FIXATION

2  
3 BACKGROUND OF THE INVENTION  
4

## 5 1. Field of the Invention

6 This invention relates broadly to orthopedic fixation  
7 devices. More particularly, this invention relates to threaded  
8 pins for treatment of fractures, particularly of the distal radius  
9 bone.

10  
11 2. State of the Art

12 Treatment of bone fractures, and particularly distal radius  
13 fractures, depends on the type of fracture. In a distal radius,  
14 Type I fractures include an undisplaced non-articular fracture of  
15 the distal radius that defines a distal radius fragment. Type I  
16 fractures do not require reduction or are stable post-reduction.  
17 Type II fractures include a medial/lateral or volar/dorsal non-  
18 articular displaced fracture which also defines a distal radius  
19 fragment. Type II fractures are reducible closed, but remain  
20 unstable.

21  
22 Type I fractures are typically treated with casting. Casting  
23 provides immobilization and the traditional immobilization period  
24 is six to eight weeks, followed by a course of physiotherapy to  
25 restore range of motion. The length of the immobilization and the

1 resulting loss of range of motion is undesirable to many patients,  
2 including athletes, artists, musicians, and patients with an  
3 economic urgency to return to work.  
4

5 Current treatment of Type II fractures includes inserting a  
6 threaded pin across the fracture. However, pin implantation is  
7 not always entirely successful. One drawback with many threaded  
8 pins in treating distal radius fractures is that their blunt tips  
9 will not always engage the radius shaft cortex and will slide into  
10 the intramedullary canal, thereby limiting the amount of proximal  
11 purchase of the pin. This is a particular concern with fractures  
12 of older osteoporotic bone. In these patients, better purchase  
13 would allow more aggressive physiotherapy. In addition, the  
14 threaded fixation pins adapted for treatment of distal radius  
15 fractures are available in a single length and thus need to be cut  
16 after insertion. The cut ends of the pins interfere with early  
17 range of motion and, to a limited extent, irritate the  
18 subcutaneous tissue and may interfere with extensor tendon  
19 function. Moreover, as the pins protrude above the bone surface,  
20 a second operation is require to remove the pins.  
21

#### 22 SUMMARY OF THE INVENTION

23

24 It is therefore an object of the invention to provide a  
25 fixation device for the treatment of Type I fractures that require

1 early mobilization and Type II fractures that are reducible closed  
2 but unstable.

3  
4 It is another object of the invention to provide a fixation  
5 device that permits immediate post-operative range of motion.

6  
7 It is a further object of the invention to provide a fixation  
8 device that is adapted for increased purchase in the bone.

9  
10 It is an additional object of the invention to provide a  
11 fixation device that will not irritate subcutaneous tissue or  
12 interfere with extensor tendon function.

13  
14 It is also an object of the invention to provide a fixation  
15 device that does not require removal after insertion.

16  
17 It is still another object of the invention to provide a  
18 fixation device that is relatively easy to insert into bone.

19  
20 It is yet another object of the invention to provide a  
21 fixation device particularly adapted for treatment of distal  
22 radius fractures, and which may also be used for the treatment of  
23 other fractures, such as olecranon fractures and malleolus  
24 fractures.

1 In accord with these objects, which will be discussed in  
2 detail below, an internal fixation device comprises a threaded pin  
3 having first and second longitudinal portions. The first portion  
4 has a first diameter and threads of a first thread diameter, and  
5 the second portion has a relatively larger second diameter and  
6 threads of a relatively larger second thread diameter.

7  
8 According to a preferred aspect of the invention, the threads  
9 on each of the first and second portions have the same pitch and  
10 thread depth. The first portion includes a self-tapping tip  
11 adapted to provide increased purchase in the radial shaft cortex.  
12 No enlarged head portion is provided to the pin at the end  
13 opposite the tip.

14  
15 According to another preferred aspect of the invention, a  
16 preferably non-threaded shaft portion is frangibly connected to  
17 the second portion and is a means by which to rotate the pin for  
18 threaded insertion into bone. In particular, the shaft portion  
19 is adapted to be received in a chuck of a drill device such that  
20 the pin may be rotated by the drill device. In order to  
21 facilitate decoupling of the shaft portion from the second portion  
22 (i.e., after pin insertion), a circumferential channel is  
23 preferably provided at the intersection of the second portion and  
24 the shaft portion.

25

1 According to yet another preferred aspect of the invention,  
2 the second portion is provided with a plurality of, and preferably  
3 three, circumferentially spaced-apart longitudinal grooves  
4 adjacent its intersection with the shaft portion.

5  
6 In use, the pin is held by the shaft portion and rotatably  
7 inserted into bone across the fracture. The self-tapping tip  
8 facilitates initial insertion into the bone as well as purchase of  
9 the tip of the pin in the radial shaft cortex. The threads on the  
10 first portion provide a stable engagement with the shaft of the  
11 bone proximal of the fracture. The wider threads at the second  
12 portion provide superior purchase on the distal fragment of bone  
13 located distal of the fracture. In addition, the headless design  
14 does not cause the distal fragment to be compressed against the  
15 radial shaft from which it separated. Further, by providing the  
16 first and second portions with threads of the same pitch and  
17 thread depth, the reduction of the fracture provided by the  
18 physician is not disturbed or acted against by the screw, but  
19 rather maintained. The pin is inserted until the second portion  
20 is flush with or slightly recessed into the distal fragment. The  
21 shaft of the pin is then removed from the pin, e.g., by bending or  
22 cutting.

23  
24 The plurality of grooves at the second portion provide a  
25 means for rotating the pin after the shaft is removed, as

1 described below. Thus, should pin removal be necessary after  
2 insertion, the headless pin can be retrieved. To that end, a  
3 driver device including a handle and a shaft provided with a  
4 socket is provided. The socket is adapted to be positioned over  
5 the end of the second portion of the pin (after the shaft has been  
6 removed) and to rotationally interfere with the grooved end of the  
7 second portion of the pin. As such, rotation of the driver  
8 permits removal of the pin from bone after the pin has been  
9 threadably inserted flush with or recessed into the distal  
10 fragment bone.

11  
12 The pin may be used to treat olecranon fractures, malleolus  
13 fractures, and fractures of similar bones, and provides the same  
14 above described advantages when used therefor.

15  
16 Additional objects and advantages of the invention will  
17 become apparent to those skilled in the art upon reference to the  
18 detailed description taken in conjunction with the provided  
19 figures.

#### 20 21 BRIEF DESCRIPTION OF THE DRAWINGS

22  
23 Fig. 1 is a perspective view of a distraction pin according  
24 to the invention;

1 Fig. 2 is a side elevation view of the distraction pin  
2 according to the invention;

3  
4 Fig. 3 is a longitudinal section view of the distraction pin  
5 according to the invention;

6  
7 Fig. 4 is an exploded perspective view of the pin, with shaft  
8 removed, and the driver device of the invention;

9  
10 Fig. 5 is an enlarged broken perspective view of a second  
11 portion of the pin and a socket of the driver; and

12  
13 Fig. 6 is an enlarged broken perspective view a mill tool  
14 according to the invention.

15  
16 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

17  
18 Turning now to Figs. 1 through 3, an internal fixation device  
19 comprises a preferably stainless steel pin 10 having a first and  
20 second longitudinal portions 12, 14. The first portion 12 has a  
21 first diameter and threads 16 of a first thread diameter, and the  
22 second portion 14 has a relatively larger second diameter and  
23 threads 18 of a relatively larger second thread diameter. Threads  
24 16 and 18 extend in the same rotational direction, are  
25 substantially uninterrupted along the length of the pin, and

1 preferably are continuous with each other. That is, threads 16  
2 preferably become threads 18 at the change in diameter from first  
3 portion 12 to second portion 14. Preferably there is no length of  
4 pin 10 between the first and second portions 12, 14 absent of  
5 threads, with the exception of the below described tip 20. In a  
6 preferred embodiment suitable for fixation of Type I and Type II  
7 distal radius fractures, the first portion has a length of  
8 approximately 2.55 inches and a diameter of approximately 0.125  
9 inch, and the second portion has length of approximately 0.6 inch  
10 and a diameter of approximately 0.015 inch, although pins having  
11 other relative dimensions may be used.

12  
13 According to a preferred aspect of the invention, the threads  
14 16, 18 on each of the first and second portions 12, 14 have the  
15 same pitch and thread depth. A currently preferred thread pitch  
16 is forty threads per inch, and a preferred thread depth is 0.016  
17 inch. The first portion 12 includes a self-tapping tip 20 adapted  
18 to provide increased purchase in the radial shaft cortex. The tip  
19 20 is preferably conical and defined by a surface 22 at a 30°  
20 angle relative to the longitudinal axis A of the pin (Fig. 3). In  
21 addition, the tip 12 preferably includes three cutting flutes 24.  
22 As such, the tip is a drill as well as self-tapping.

23  
24 The pin 10 does not include a conventional enlarged head  
25 portion opposite the tip 20. Rather, the pin 10 is provided with



1 a preferably non-threaded shaft portion 26 which is preferably  
2 smaller in diameter than the second portion 14. The shaft portion  
3 26 is a means by which to rotate the pin 10 for threaded insertion  
4 into bone. In particular, the shaft portion is adapted to be  
5 received in a chuck of a drill device. As such, the shaft portion  
6 26 may be circular, hexagonal or any other shape in cross-section,  
7 provided it may be gripped by a rotational driving tool. The  
8 shaft portion preferably has a length of approximately 0.8 inch  
9 and a diameter of 0.09 - 0.10 inch.

11 According to another preferred aspect of the invention, the  
12 shaft portion 26 is intended to be decoupled from the second  
13 portion 14. In order to facilitate decoupling of the shaft  
14 portion 26 from the second portion 14, a circumferential channel  
15 28 is preferably provided at the intersection of the second  
16 portion and the shaft portion. The channel is preferably  
17 approximately 0.02 to 0.03 inch wide and preferably approximately  
18 0.025 inch deep. Then, when the shaft portion 26 is desired to be  
19 separated from the pin 10, the shaft portion may be frangibly  
20 detached from the second portion, e.g., by bending. If the shaft  
21 portion 26 cannot be frangibly separated, the channel 28 provides  
22 a guide and a purchase for a cutting instrument to act on the pin  
23 10 to separate the shaft portion 26 from the pin. It is  
24 recognized that even if a channel is not provided to the pin, the  
25 shaft portion may nevertheless be removed by cutting.

1  
2 According to yet another preferred aspect of the invention,  
3 the second portion 14 is provided with a plurality of  
4 circumferentially spaced-apart longitudinal grooves 30 adjacent  
5 its intersection with the shaft portion 26. The grooves are  
6 channels, furrows, flutes, or other preferably longitudinal  
7 negative spaces defined about the circumference of the second  
8 portion. Most preferably, three grooves 30 are provided and  
9 preferably spaced apart 120° about the circumference of the second  
10 portion 14 and preferably have a depth which extends below the  
11 threads 18.

12  
13 Prior to use, if necessary, the fracture is first reduced.  
14 Then, the shaft portion 26 of the pin 10, engaged in a chuck of a  
15 drill or other rotational driving device, is percutaneously  
16 introduced to the bone and rotationally drilled through the distal  
17 fragment, across the fracture, and into the radial shaft cortex.  
18 The self-tapping tip 20 facilitates initial insertion into the  
19 bone and as well as purchase of the tip in the radial shaft  
20 cortex. The threads 16 on the first portion 12, with their  
21 particular depth and pitch, provide a stable engagement with the  
22 shaft of the radial shaft bone proximal of the fracture. As the  
23 pin is inserted further, the second portion 16 enters the distal  
24 fragment and the wider threads 18 provide superior purchase on the  
25 distal fragment of bone. The pin 10 is inserted until the

1 intersection of the second portion 16 and the shaft portion 26  
2 lies flush with, or more preferably slightly recessed relative to,  
3 the surface of the distal fragment. The shaft of the pin is then  
4 removed from the pin, e.g., by bending or cutting. It is noted  
5 that the headless design does not cause the distal fragment to be  
6 compressed against the radial shaft from which it separated. In  
7 addition, by providing the first and second portions 12, 14 with  
8 threads of the same pitch and thread depth, the reduction of the  
9 fracture provided by the physician is not disturbed or acted  
10 against by the screw, but rather maintained. In fact, unlike  
11 other fixation pins, the pin of the invention can be used to  
12 maintain a reduced fracture in a distracted state.

13  
14 Referring to Figs. 4 and 5, after the shaft portion has been  
15 removed from the pin, the plurality of grooves 30 are accessible  
16 at the end of the second portion. The grooves 30 provide a means  
17 for engaging the pin 10 such that, should pin removal be necessary  
18 after insertion, the headless pin can be retrieved. To that end,  
19 a driver 40 including a handle 42 and a shaft 44 provided with a  
20 socket 46 is provided. The handle 42 is preferably provided with  
21 finger engagement structure, e.g., circumferential ridges 48 and  
22 corresponding grooves 50, for gripping by the hand of a physician,  
23 as well as a rounded back 52 adapted to seat in the palm of a  
24 physician's hand. The socket 46 is adapted to be positioned over  
25 the end of the second portion 14 and provide rotational

1 interference with the second portion. For example, the socket 46  
2 may include internal ribs 54 adapted to rotationally interfere  
3 with the second portion 14 at the grooves 30. As such,  
4 positioning the socket 46 over the end of the second portion of  
5 the pin and rotating the driver 40 in a first direction causes  
6 extraction of the pin from the bone, while rotating the driver in  
7 an opposite second direction causes the pin 10 to be further  
8 seated (or reseated) in the bone.

9  
10 Turning now to Fig. 6, it is recognized that the socket 46  
11 has a larger diameter than the end of the second portion 14 of the  
12 pin 10. Therefore, if it is desirable to remove a recessed pin,  
13 it may be necessary to remove a small amount of bone to provide  
14 access for the socket to fit over the pin. To that end, it is  
15 preferable that a mill tool 60 be provided. The mill tool 60  
16 includes a shaft 62 provided with a head 64 having a plurality of  
17 serrations 66 or other bone removing structure about its  
18 periphery. The serrations 66 are adapted to remove bone when the  
19 mill tool is rotated about the longitudinal axis of the shaft 62.  
20 The head 64 of the mill tool preferably has an outer diameter  
21 which is substantially equivalent to the outer diameter of the  
22 socket 46. The mill tool 60 may be provided in a handle similar  
23 to handle 42. For example, the shaft 44 of the socket 46 may be  
24 removable from the handle 42 so that the shaft 62 of the mill tool  
25 60 may be received therein. Alternatively, a handle (not shown)

1 which includes the mill tool 60 extending in one direction, and  
2 the socket 46 extending in another direction, e.g., an opposite  
3 direction or at an angle relative thereto, may be used.

4  
5 There have been described and illustrated herein an  
6 embodiment of a fracture fixation pin. While a particular  
7 embodiment of the invention has been described, it is not intended  
8 that the invention be limited thereto, as it is intended that the  
9 invention be as broad in scope as the art will allow and that the  
10 specification be read likewise. Thus, it will be appreciated that  
11 pins of other dimensions, having one or more of the preferred  
12 aspects of the invention are in accord with the scope of the  
13 invention. In addition, while particular thread pitches and  
14 depths have been disclosed, it will be understood that the threads  
15 of the pin can have other pitches and depth. Also, while the  
16 shaft portion is preferably frangibly connected to the threaded  
17 portion, it will be recognized that the shaft portion may be  
18 otherwise coupled thereto. For example, the shaft portion can be  
19 threadably coupled to the second portion in a manner in which the  
20 shaft portion and second portion are coupled when the shaft  
21 portion is rotated in the first rotational direction and  
22 threadably uncoupled when the shaft portion is rotated in the  
23 second rotational direction. Alternatively, the shaft portion may  
24 be interference fit in a socket at the end of the second portion.  
25 For example, the shaft portion may have a hex wrench end and the

1 second portion may have a hex socket end into which the hex wrench  
2 end is received. It will therefore be appreciated by those  
3 skilled in the art that yet other modifications could be made to  
4 the provided invention without deviating from its spirit and scope  
5 as claimed.